SEASONAL POPULATIONS and FLIGHT PATTERNS of SEVERAL NOCTUID MOTHS in SOUTH-CENTRAL ARIZONA

Production Research Report No. 100

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

Contents

Washington, D. C. Issued July 1968

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SEASONAL POPULATIONS AND FLIGHT PATTERNS OF SEVERAL NOCTUID MOTHS IN SOUTH-CENTRAL ARIZONA

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Several lepidopterous insects of the family Noctuidae are economic pests of vegetable crops throughout the United States. Many of them also damage cotton and other crops as well as ornamentals.

The cabbage looper (*Trichoplusia ni* (Hübner)) attacks many crops, including cabbage, lettuce, peas, celery, potatoes, and cotton, some ornamentals, and sometimes cucurbits. *Heliothis zea* (Boddie) is known by several common names depending on the crop attacked, such as the corn earworm, tomato fruitworm, and cotton bollworm. This insect is also an important pest of lettuce, entering the heads in the early formative stages and developing unnoticed until harvest, when the presence of "worms" may result in condemnation of the entire field of lettuce. The beet armyworm (*Spodoptera exigua* (Hübner)) attacks several vegetable crops and ornamentals as well as sugarbeets and is an important pest of cotton in some areas. The yellow-striped armyworm (*Prodenia ornithogalli* Guenée) is also a general feeder and a pest of vegetable crops and sugarbeets in some areas.

Cutworms are a universal pest of many crops, and several species occur in the Southwest. Cutworm moths are attracted to lights, but to classify and count all species would have been physically impossible in this study. In south-central Arizona the granulate cutworm (*Feltia subterranea* (F.)) is one of the more predominant species and was therefore selected in this study as representative of the cutworm group.

Studies were conducted from 1963 through 1966 in irrigated agricultural and nearby desert areas of south-central Arizona to determine the seasonal occurrence and flight patterns of these insects by means of light traps. These studies were directed primarily toward the cabbage looper, but detailed information was also obtained on the corn earworm, beet armyworm, yellow-striped armyworm, and granulate cutworm. Records were also kept on the alfalfa looper (*Autographa californica* (Speyer)). However, it was considered of minor economic importance and detailed population data are not given.

SURVEY TRAPS

Survey type light traps, each with one 15-watt fluorescent blacklight (BL) lamp (fig. 1), similar to those described by Harding et al.,[1] were used for these studies. Eight of these BL traps were set up in the east end of the Salt River Valley in May 1963. In July of the same year two traps were placed in adjacent desert areas, and in November two more traps were placed in the desert. Approximate distances and directions of these traps from cultivated areas were 2½ miles north, 10 miles north, 3 miles northeast, and 12 miles east. Trap locations are shown in figure 2.

Each trap was time-switch operated from dusk to daylight every night, and collections were made three times a week, except during the summer when catches were too large to handle on this basis. During this period the

[1] HARDING, W. C., HARTSOCK, J. G., and ROHWER, G. G. BLACK LIGHT TRAP STANDARDS FOR GENERAL INSECT SURVEYS. Ent. Soc. Amer. Bul. 12 (1): 31–32. 1966.

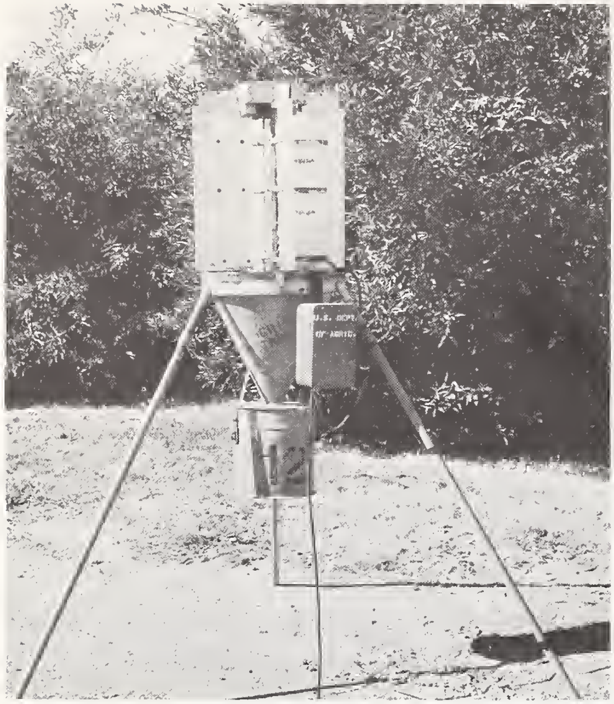

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Figure 1.—Light trap with 15-watt fluorescent BL lamp, time switch, and cyanide canister.

traps were operated only 1 night each week. About 20 grams of calcium cyanide sealed in a small paper bag was placed in each collection can. Dead insects were identified and counted in the laboratory.

Data are presented graphically on a per trap per night basis. They are weekly averages of all traps within the cultivated and desert areas, respectively, and are plotted on a logarithmic scale. The lowest population shown is 0.1, but this does not necessarily mean that no moths were flying during the periods indicated below this point.

To obtain additional information on the comparative occurrence of noctuid moths of economic concern in cultivated and desert areas, portable battery-powered 15-watt BL traps were set up in 10 locations for 1-night operation during June, July, and August of 1964. These traps were arranged in a rough semicircle, 10 to 80 miles or more south and west of the irrigated areas in south-central Arizona. The location of these more distant traps in relation to those in or near the Salt River Valley is also shown in figure 2.

The range of attractiveness of 15-watt BL lamps to the noctuids under study was also investigated as was the effect of moonlight on the trap catch of these insects.

RANGE OF ATTRACTIVENESS OF 15-WATT FLUORESCENT BL LAMPS TO SOME NOCTUID MOTHS

Preliminary experiments with release and recovery of marked cabbage looper moths indicated that response of these insects to 15-watt BL lamps dropped off rapidly between 50 and 100 feet. An experiment was therefore set up to determine the range of attractiveness of these lamps not only to cabbage looper moths but also to the other species being studied.

Nine 15-watt BL traps (fig. 1) were set up in an alfalfa field near Mesa, Ariz. They were arranged in triangles, as shown in figure 3, and each group was approximately 500 feet apart. The circles in this diagram have a 50-foot radius, which represents the "assumed field of attractiveness" of the lamps to the moths. In figure 3, *A*, the overlap of the assumed fields of attractiveness was approximately 50 percent. In figure 3, *B*, no overlapping occurred, but the assumed fields of attractiveness were adjoining. In figure 3, *C*, these fields were well separated. All traps were run for 16 nights during the last part of September and collections were made daily. The average catch per trap per night for each group of traps is given in table 1.

It was assumed no interference occurred between traps 200 feet apart; therefore, these traps were the standard for comparison with the other two groups. The percent reduction in the moths obtained in traps 50 and 100 feet apart over the average catch in traps 200 feet apart was calculated. Data indicate a reduction of 41 to 45 percent for moths of the cabbage looper, corn earworm, beet armyworm, and yellow-striped armyworm in traps 50 feet apart. They also show a reduction for the same insects of 18 to 27 percent where traps were 100 feet apart. The daily catch for moths of the granulate cutworm was reduced only 18 per-

cent in traps 50 feet apart and there was no reduction in traps 100 feet apart. It was therefore assumed that the maximum field of attractiveness of a 15-watt BL lamp to moths of the cabbage looper, corn earworm, beet armyworm, and yellow-striped armyworm extends to 50 feet with less attraction up to 100 feet, but that the field of attractiveness to moths of the granulate cutworm is less than 50 feet.

TABLE 1.—*Average catch of noctuid moths in BL traps arranged in various patterns,*[1] *Mesa, Ariz., Sept. 16 to Oct 1, 1964*

Species	Catch per trap per night when distance between traps was—		
	50 feet	100 feet	200 feet
	Number	*Number*	*Number*
Cabbage looper	6	9	11
Corn earworm	20	28	34
Beet armyworm	41	53	73
Yellow-striped armyworm	18	24	32
Granulate cutworm	49	61	60

[1] See figure 3.

To check further on the range of attractiveness of a 15-watt fluorescent BL lamp to moths of the cabbage looper and beet armyworm, reared specimens were released during September and October 1964 at 50, 100, and 200 feet from one trap located in the center of a large alfalfa field. Each release was made in the four cardinal directions from the trap. Moths were marked so that the distance and direction from the trap could be determined.

Data in table 2 show that the recovery of cabbage looper moths dropped off rapidly between 50 and 100 feet, with very few moths recov-

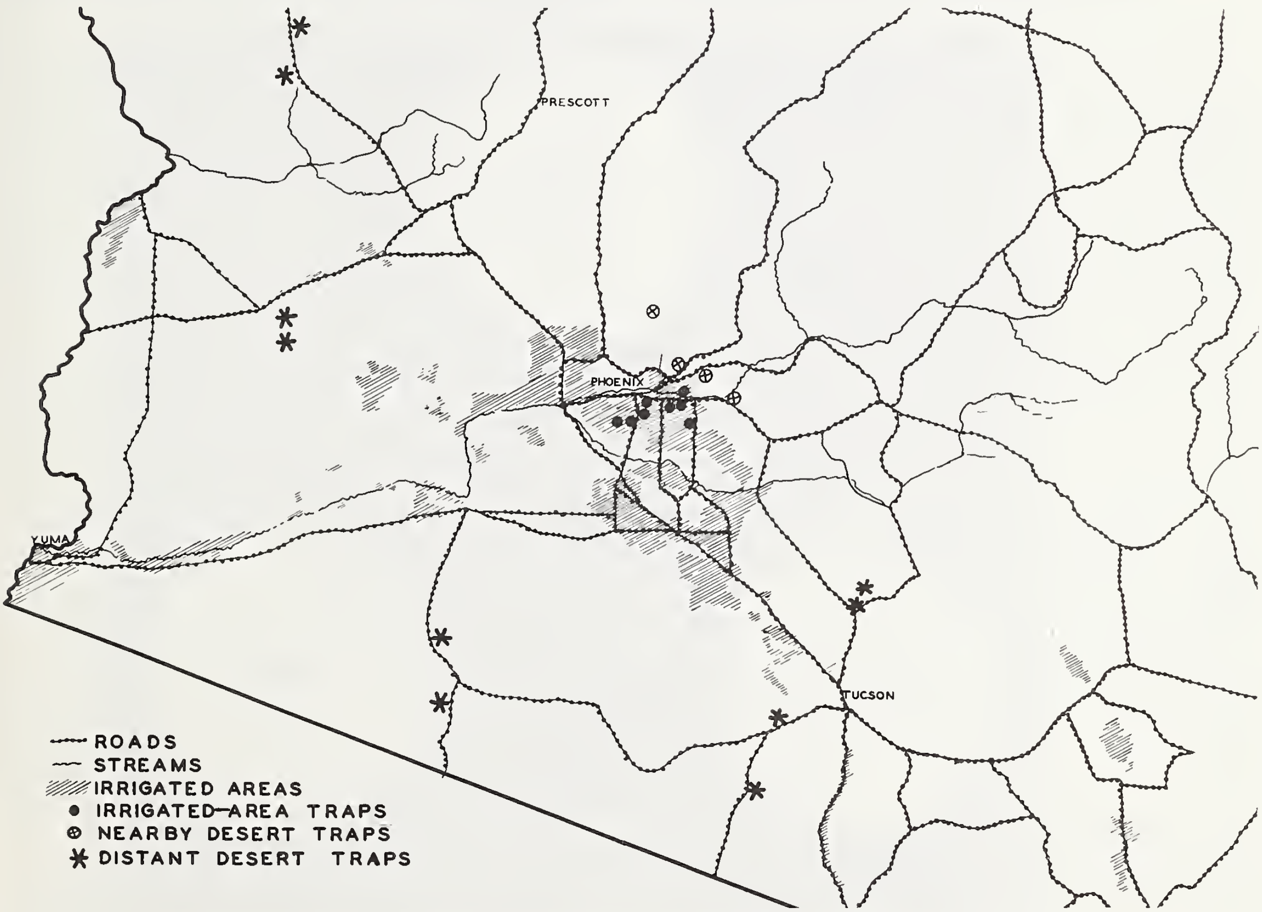

FIGURE 2.—Location of BL traps in south-central Arizona.

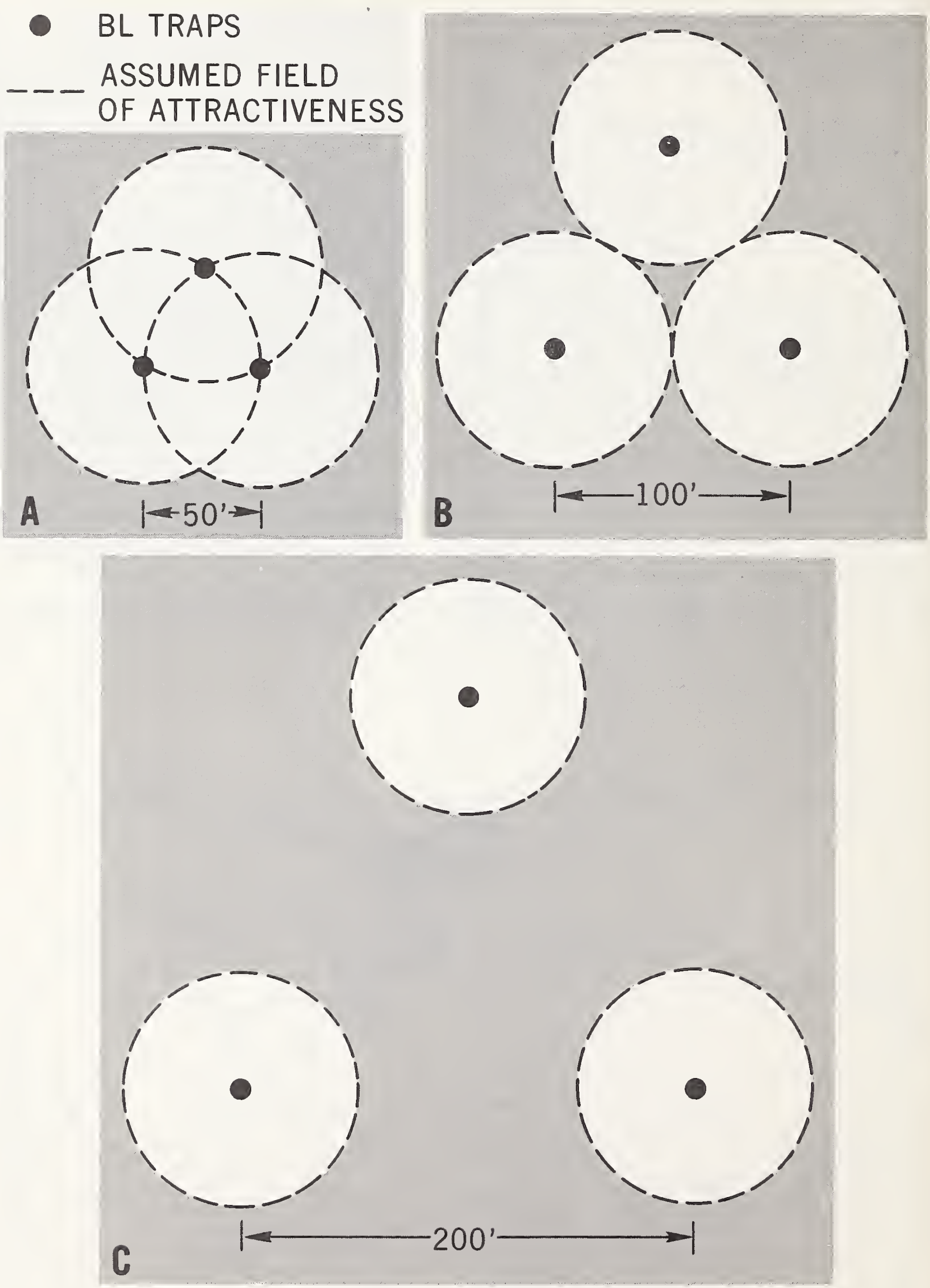

FIGURE 3.—Trap arrangements to determine effective distance of 15-watt BL lamps.

TABLE 2.—*Release and recovery of cabbage looper and beet armyworm moths at various distances from BL trap, Mesa, Ariz., 1964*

Release period	Distance from trap	Total released	Total recovered
CABBAGE LOOPER			
	Feet	*Number*	*Percent*
Sept. 10–25	50	403	21
	100	808	7
Oct. 1–5	100	508	4
	200	1,061	1
BEET ARMYWORM			
Sept. 28–29	50	236	12
	100	418	2
Oct. 1–14	100	837	13
	200	1,654	3

ered at 200 feet. A greater percentage of beet armyworm moths than cabbage looper moths was recovered at 100 and 200 feet, but recoveries of armyworm moths were also comparatively low at 200 feet. These data indicate that the field of attractiveness of a 15-watt BL lamp to cabbage looper moths dropped off rapidly between 50 and 100 feet, but that beet armyworm moths may be attracted to the light at a somewhat greater distance. Recovery data also indicate that the moths flew in all directions, but they tended to fly from south to north.

Even though the 15-watt BL lamps attracted noctuid moths a comparatively short distance, these insects are very active, strong fliers. Therefore it was assumed that whenever they came within the range of attractiveness of the traps, sufficient numbers were caught to make a valid comparison of their seasonal population.

EFFECT OF MOONLIGHT ON BL TRAP EFFICIENCY

The effect of moonlight on BL trap catches of cabbage looper moths was observed from May 25 to November 30, 1965, incidental to other studies involving 25 traps with 15-watt BL lamps in an area east of Chandler, Ariz. Daily collections were made and average numbers per trap per night are indicated in figure 4. A trend line was drawn. Dates of full moon are indicated and also precipitation is shown from two nearby Weather Bureau stations at Chandler and Chandler Heights.

A definite drop in catches occurred during the moonlight periods (fig. 4). Each time this drop began a few days before full moon, and trap catches increased immediately after full moon. The low point just before full moon is probably due to the moon rising earlier in the evening during this period, and therefore the moonlight competed with the light from the traps at a time of the greatest moth activity. No correlation is indicated between catch of looper moths and precipitation (fig. 4).

There was some speculation as to whether this drop in moth catch during moonlight periods was attributable to less efficiency of the traps or less activity of the moths. Data obtained in 1966 experiments with the synthetic female sex attractant (*cis*-7 dodecen-1-01 acetate) of the cabbage looper, developed by Berger,[2] have shown that male moth activity during moonlight periods is not slowed down but may be accelerated (fig. 5).

An experiment in August and September and another in September and October were designed primarily to establish the degradation of a given quantity of pheromone. The effect of moonlight on the trap catches was incidental. In each experiment a small cloth bag containing 40 grams of sand impregnated with *cis*-7 dodecen-1-01 acetate was placed directly above the BL traps. In the first experiment the pheromone was placed above the trap on August 24, and by September 6 its effectiveness had disappeared. In the second experiment the pheromone was placed above the trap on September 18, and by October 4 its effectiveness had disappeared.

Four concentrations of the pheromone were used in both of these experiments and each was replicated five times and compared with five unbaited BL traps. The traps were arranged in a 5 by 5 latin square and baits were shifted daily to form a different latin square each night. Only averages of the more effective concentrations are given in figure 5. They are shown for the pheromone-baited traps and the check traps, 10 days before and 10 days after full moon in each case. A trend line was drawn as in figure 4.

The difference in BL trap catch during moonlight periods in the 1965 experiments and in the 1966 experiments with and without the sex attractant indicates reduced trap efficiency rather than reduced moth activity.

[2] BERGER, R. S. ISOLATION, IDENTIFICATION, AND SYNTHESIS OF SEX ATTRACTANT OF THE CABBAGE LOOPER, TRICHOPLUSIA NI. Ent. Soc. Amer. Ann. 59 (4): 767–771. 1966.

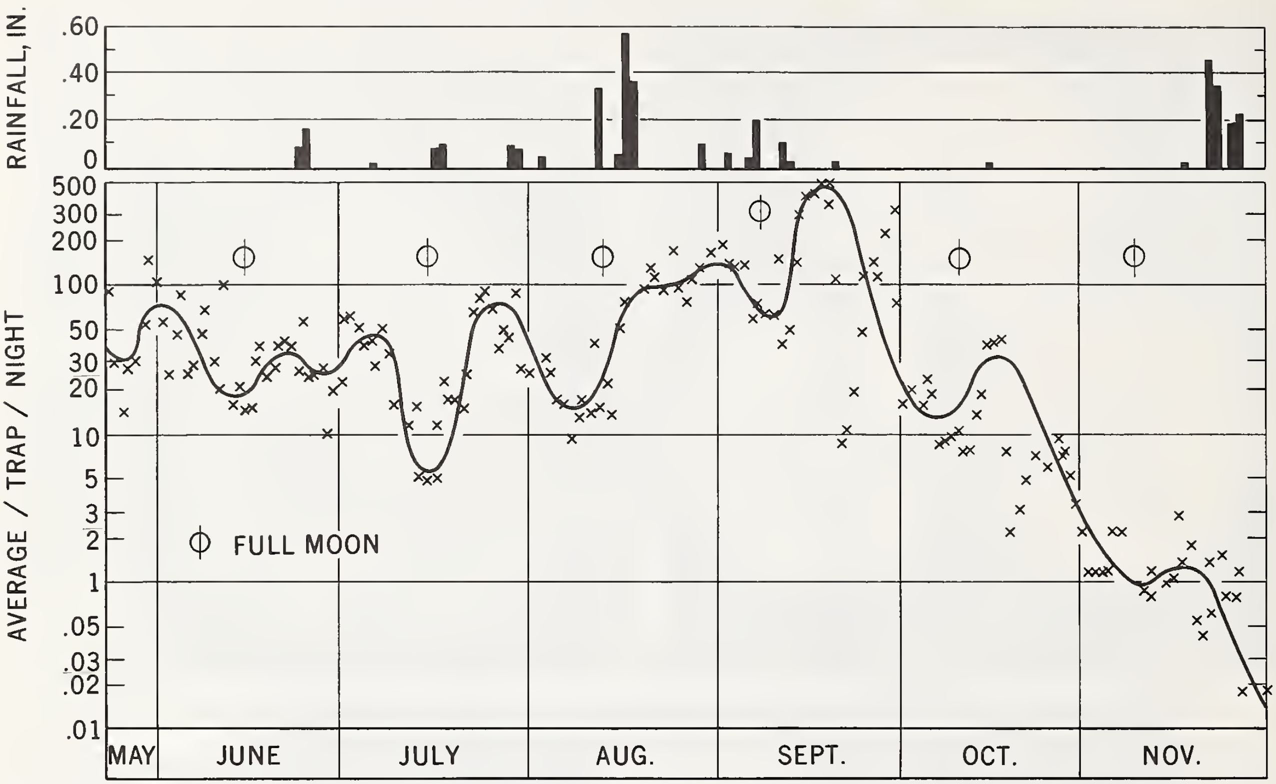

FIGURE 4.—Effect of moonlight on catch of cabbage looper moths in BL traps, 1965. X indicates average number caught per trap per night.

SEASONAL POPULATIONS AND FLIGHT PATTERNS OF SIX NOCTUID MOTHS IN IRRIGATED AND DESERT AREAS

Cabbage Looper

Flight patterns of cabbage looper moths show seasonal population peaks in August or September each year (fig. 6). In 1963, 1965, and 1966, definite peaks also occurred in May with population declines in June and July. In 1964, populations during June and July were similar to the other 3 years, but there was no spring peak. Catches in the desert traps show the same general population trend as in the cultivated-area traps, but were usually lower. These observations would indicate that the cultivated area is the primary breeding source.

Data from the portable traps in table 3 show that no cabbage looper moths were taken in these distant desert traps (fig. 2) during June and July. In August when populations within or near the cultivated area were high, some moths were taken in the more distant traps. In August 1964, the average catch per trap per night was 50 to 100 moths within the cultivated area, 20 to 50 in the nearby desert, and only 1.3 in the distant traps.

TABLE 3.—*Average catch of noctuid moths per trap per night 10 to 80 miles from cultivated area, Arizona, 1964* [1]

Date	Cabbage looper	Corn earworm	Beet armyworm
	Number	*Number*	*Number*
June	0	0.3	8.8
July	0	.5	17.8
August	1.3	4.1	23.6

[1] Average of 6, 4, and 10 catches for June, July, and August, respectively.

McKinney[3] listed the more important culti-

[3] McKINNEY, K. B. THE CABBAGE LOOPER AS A PEST OF LETTUCE IN THE SOUTHWEST. U.S. Dept. Agr. Tech. Bul. 846, 30 pp. 1944.

vated and wild desert breeding hosts of the cabbage looper in Arizona. Except for wild tobacco (*Nicotiana trigonophylla* Dunal and *N. glauca* Graham), all wild desert plants listed are annuals and dependent on seasonal rainfall for germination. He discussed the relative importance of the desert breeding areas of the cabbage looper in 1935, pointing out that from December 1934 to March 1935 rainfall recorded at Phoenix was more than twice the normal for this period and that loopers were easily found on several species of desert plants. He also re-

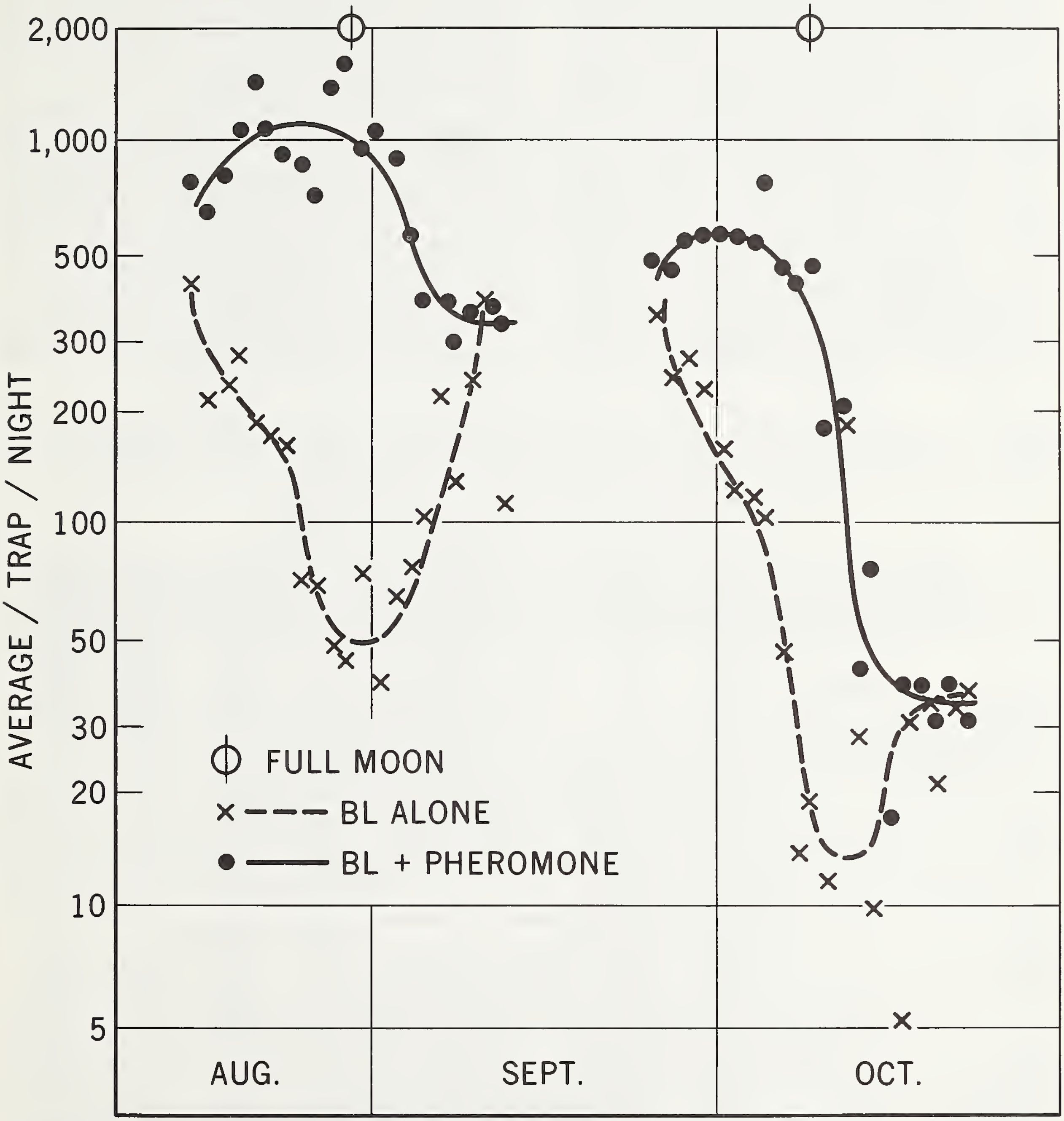

FIGURE 5.—Effect of moonlight on catch of male cabbage looper moths in BL traps with and without female sex attractant, 1966.

ported favorable conditions for summer annuals on the desert and collected looper larvae in considerable numbers during August and September on *Pectis papposa* Harvey and Gray ex Gray, 15 to 35 miles from cultivated areas.

Information obtained from 1963 to 1966 indicates that although the cabbage looper may at times reproduce on wild desert annuals, the primary source is cultivated crops or weeds within the cultivated area. As populations increase within the cultivated area, the insects move into nearby and eventually more distant desert areas. If rainfall has been sufficient to supply suitable host plants, breeding may continue for a time in these desert areas.

The January-March rainfall in south-central Arizona was appreciably above normal in 1965, approximately normal in 1963 and 1966, and below normal in 1964, as shown in table 4. In 1965, cabbage looper moths were taken in desert traps during January and February in appreciable numbers (fig. 6). In the cultivated-area traps one or more moths were taken each week during January and February, although catches were mostly below the 0.1 average shown in this graph. In 1964, only four cabbage looper moths were taken in cultivated-area traps during January. None were taken in desert traps during January and only two during February. In 1966, only one cabbage looper moth was taken in cultivated-area traps and one in desert traps during January and February. These data indicate that above-normal rainfall is necessary for wild host plants and the production of cabbage loopers in desert areas during the early spring.

A comparison of 1965 and 1966 cabbage looper moth populations (fig. 6) shows that numbers were very similar for these 2 years, except for the early appearance of looper moths in desert traps in 1965 and their complete absence during January and February 1966. The appearance of these early-season moths in the desert in 1965 apparently had little effect on subsequent generations in the cultivated area.

Rainfall during April-June is normally low (normal for the period 0.67 inch). In 3 of the 4 years studied, rainfall during April-June was

TABLE 4.—*Monthly precipitation and departure from normal for south-central Arizona, 1963–66*

[Average of 56 Weather Bureau stations]

Month	1963		1964		1965		1966	
	Precipitation	Departure from normal	Precipitation	Departure from normal	Precipitation	Departure from normal	Precipitation	Departure from normal
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
January	0.72	−0.25	0.27	−0.70	1.58	+0.61	0.78	−0.19
February	1.31	+ .35	.04	− .92	1.65	+ .69	1.52	+ .56
March	.58	+ .19	.76	− .01	1.19	+ .42	.32	− .45
Total for late winter and early spring	2.61	+ .29	1.07	−1.63	4.42	+1.72	2.62	− .08
April	.32	− .07	.20	− .19	1.62	+1.23	.01	− .38
May	0	− .14	.01	− .13	.27	+ .13	0	− .14
June	0	− .14	.04	− .10	.36	+ .22	.11	− .03
Total for late spring	.32	− .35	.25	− .42	2.25	+1.58	.12	− .55
July	.21	− .85	1.66	+ .60	.89	− .17	.65	− .41
August	3.86	+2.30	2.64	+1.08	.55	−1.01	1.74	+ .18
September	.43	− .42	1.42	+ .59	.73	− .10	2.27	+1.44
Total for summer	4.50	+1.05	5.72	+2.27	2.17	−1.28	4.66	+1.21
October	1.11	+ .52	.53	− .06	.21	− .38	.51	− .08
November	1.26	+ .66	.67	+ .07	1.24	+ .64	.60	0
December	.08	− .93	1.06	+ .05	5.23	+4.22	.58	− .43
Total for fall and early winter	2.45	+ .25	2.26	+ .06	6.68	+4.48	1.69	− .51

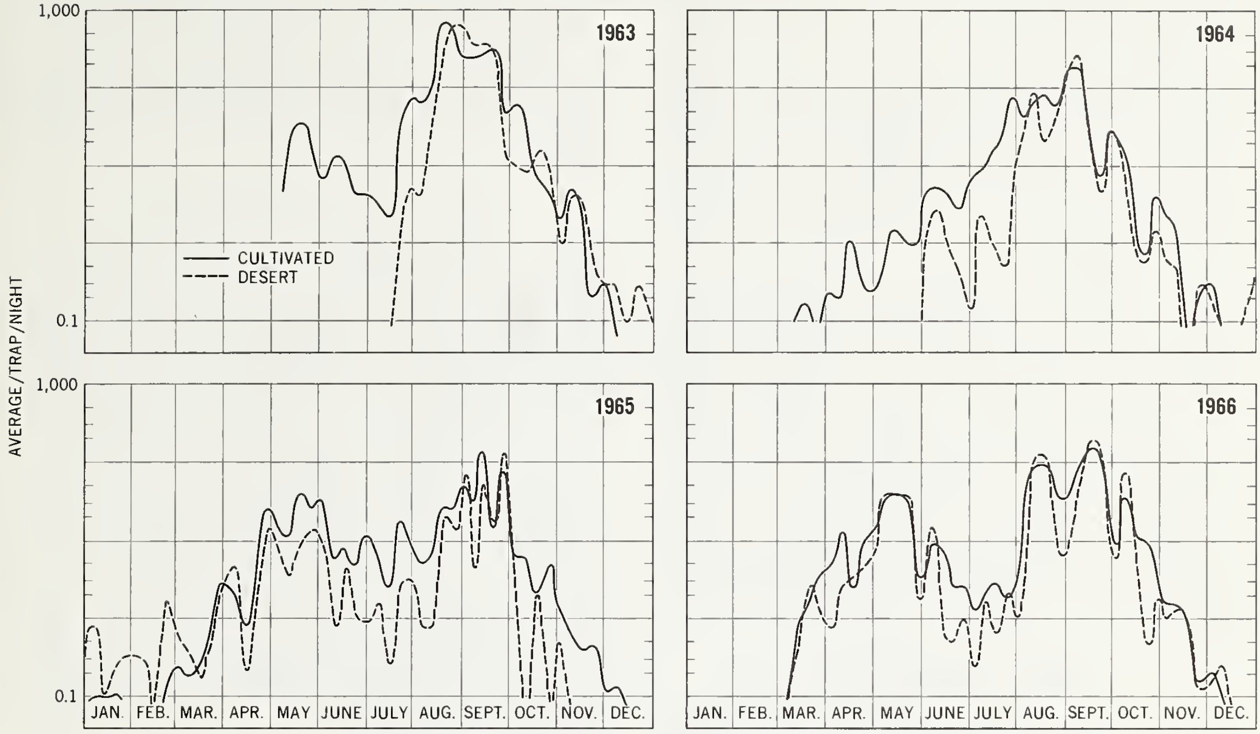

FIGURE 6.—Cabbage looper moth populations, 1963–66.

below normal, but in 1965 it was considerably above normal (table 4). However, trap catches from 1963 to 1966, inclusive, (fig. 6) show that rainfall during April-June has little effect on cabbage looper populations in either desert or cultivated areas.

Normal summer rainfall during July-September for south-central Arizona is 3.45 inches. In 3 of the 4 years studied, rainfall during this period was above normal, whereas in 1965 it was well below normal (table 4). Trap catches (fig. 6) show some differences in cabbage looper populations at the peak in August and September, but these differences do not seem to be correlated with wet and dry years.

Alfalfa Looper

The alfalfa looper is closely related to the cabbage looper and larvae and adults of both could easily be confused. In south-central Arizona this species occurs primarily during the early spring. Moth flights peak in mid-April and drop to very low numbers after mid-May. In 1966, low catches of these moths were taken during January and February; they increased during March and reached a peak of 25 per trap per night the second week in April, at which time cabbage looper moths averaged only 12. Alfalfa looper catches rapidly declined to 0 by the end of May, and only an occasional moth was taken throughout the rest of the year.

Corn Earworm

Trap catches of corn earworm moths were below 0.1 from the middle of November until the last part of March for each year studied (fig. 7). Although catches were extremely low during this period, an occasional moth was taken in the traps. During 1963–64 no corn earworm moths were taken in the traps from December 6 to March 20 nor in January or February 1965. In the cultivated-area traps one moth was taken on December 2, 9, and 27, 1965, and January 17, 22, and February 24, 1966. In the desert traps one moth was taken on December 4, 1965, and February 26, 1966.

Each year corn earworm moths increased rapidly during April and then leveled off somewhat during the spring and summer. Seasonal peaks were reached each year in August and September except 1966, when populations during May were slightly higher than the fall populations. During August and September in 1963 and 1964, collections reached peaks of 200

to 500 per trap per night, whereas for the same period in 1965 and 1966 they averaged only 30 to 50.

The four years of flight data show that populations of corn earworm moths were consistently higher in the irrigated than in the nearby desert areas. No correlation between desert populations (fig. 7) and rainfall (table 4) is shown. Both observations indicate that the primary breeding source of this insect is within the cultivated area.

In 1964 the more distant traps (fig. 2 and table 3) picked up two corn earworm moths in 6 nights in June and two in 4 nights in July, but catches averaged over four corn earworm moths per trap per night in August. At the same time the catches in the cultivated area averaged from 10 to 50 corn earworm moths per trap per night during June and July, whereas in August they averaged from 75 to 400 (fig. 7). Therefore, it seems logical to assume that most of the corn earworm moths were produced within the cultivated area and that flights penetrated farther and farther into the desert as the populations increased.

Beet Armyworm

Beet armyworm moths were taken every month during 1964–66, except January 1966 (fig. 8). Three moths actually were taken in the cultivated-area traps in January 1966, one the first week and two the fourth week. However, because the weekly averages were below 0.1 per trap per night, they cannot be shown in figure 8. Flights of these moths reached seasonal peaks in August and September in 1963, 1964, and 1965, but in 1966 the seasonal peak was in late October (fig. 8).

Although beet armyworm moths are smaller than any of the other noctuids studied, they are probably the strongest fliers. This is indicated by limited studies with release and recovery of marked reared specimens and the occurrence of relatively large numbers in desert traps as well as in the more distant portable traps.

Cultivated areas are probably the most important breeding source of beet armyworms, but they have also been found feeding in the desert on such summer annuals as *Boerhaavia* sp., *Allionia incarnata* L., *Tidestromia lanuginosa* (Nutt.) Standl., *Pectis papposa* Harvey and Gray ex Gray, and *Euphorbia* sp. Some breeding may also occur on spring annuals in the desert. Collections from the distant portable traps in 1964 show that these moths were taken consistently in these traps and that numbers increased as the season progressed (table 3). Comparing the 1964 data in figure 8 with table 3 shows that increased catches in these distant traps are directly correlated with high populations in cultivated areas. There is no definite correlation between rainfall and seasonal occurrence of the beet armyworm moths. These findings indicate that the irrigated areas are the most important source of these insects.

Yellow-Striped Armyworm

More yellow-striped armyworm moths were caught in the cultivated-area traps than 0.1 per trap per night for every month during 1964–66 (fig. 9). In the 4 years studied, trap catches in the desert were always well below those in the cultivated areas. In fact, many times this species was found in desert traps only during peak flights in the cultivated area, especially in 1964 and 1966, a definite indication that the cultivated area is the primary breeding source. Although yellow-striped armyworms have been found breeding on such desert plants as *Lycium* sp. and burroweed (*Haplopappus tenuisectus* (Greene) Blake ex Benson), it seems highly probable that most of these insects breed in the cultivated area and move into the desert where they are able to maintain themselves for a time on some of the desert shrubs or annual plants.

Granulate Cutworm

Granulate cutworm moths have been taken in considerable numbers in the cultivated-area traps every month in the year (fig. 10). The largest numbers occurred in late summer and early fall. No data are available for 1963.

Except for the nights of June 21 and August 2, 1964, and January 2, 1966, these moths have been taken in the cultivated area every night that traps were run during 1964–66. Catches in desert traps were lower than in cultivated-area traps and more erratic than for the other species studied. Population peaks in desert traps corresponded with those in cultivated-area traps but were always considerably lower. As with the yellow-striped armyworm moths, the only occurrence in desert traps was at the time of population peaks in the cultivated area. Very few or no moths were taken in the desert traps for extended periods each year. A comparison of trap catches in desert and cultivated areas from 1964 to 1966 would indicate that breeding of granulate cutworms is more closely confined to the cultivated area than that of any of the other species studied.

Very few observations have been made of cutworms feeding on desert flora. Since they feed largely underground or at least hide there

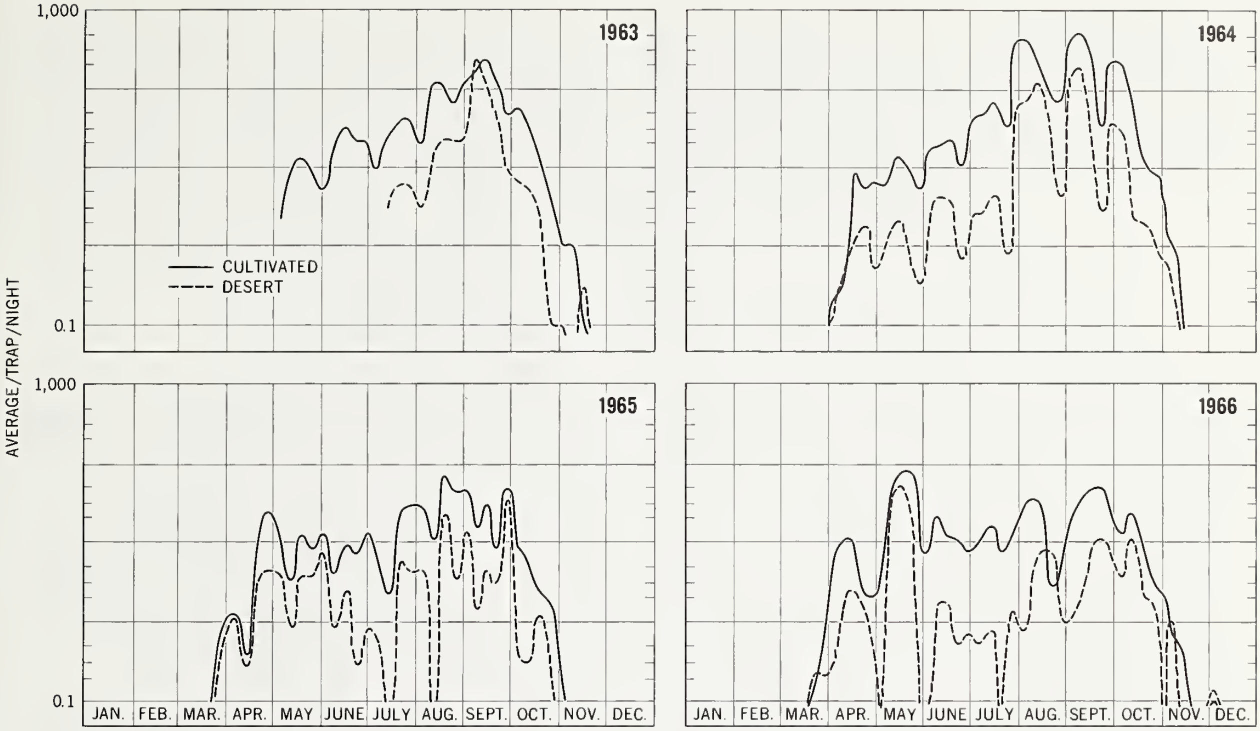

FIGURE 7.—Corn earworm moth populations, 1963–66.

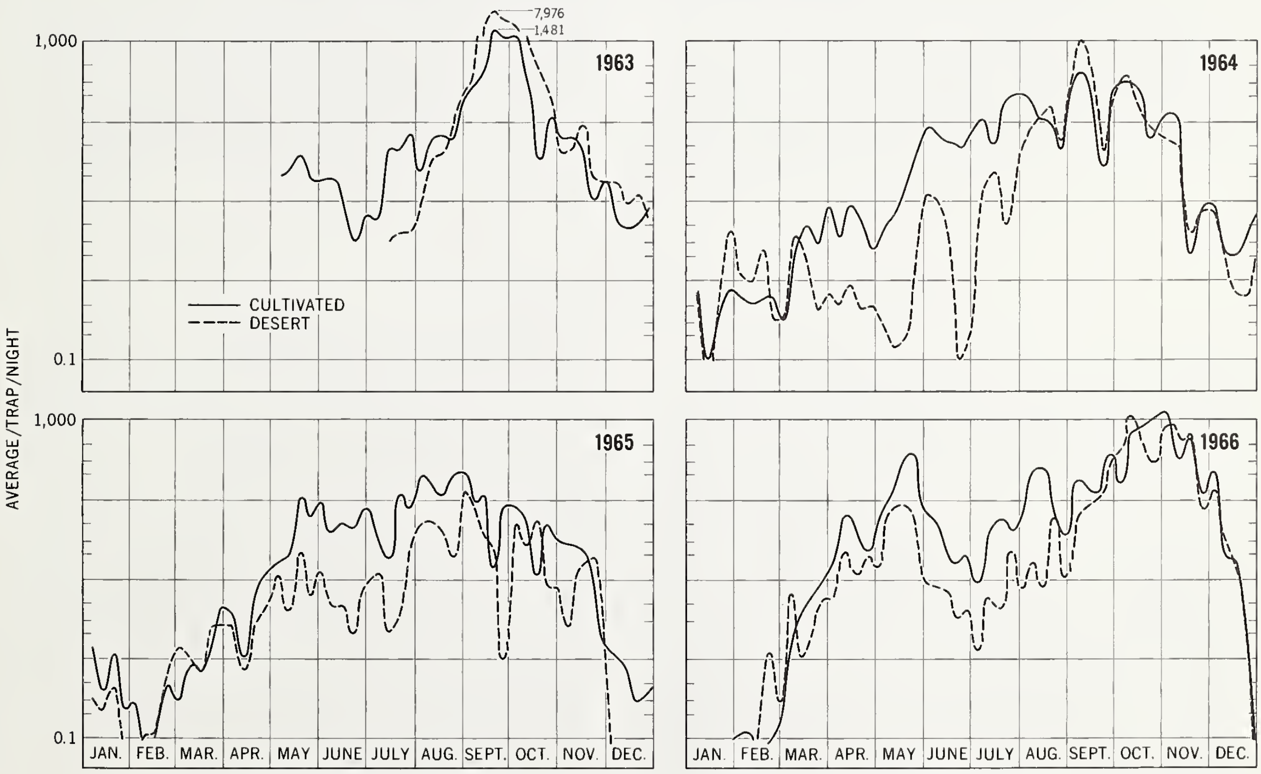

FIGURE 8.—Beet armyworm moth populations, 1963–66.

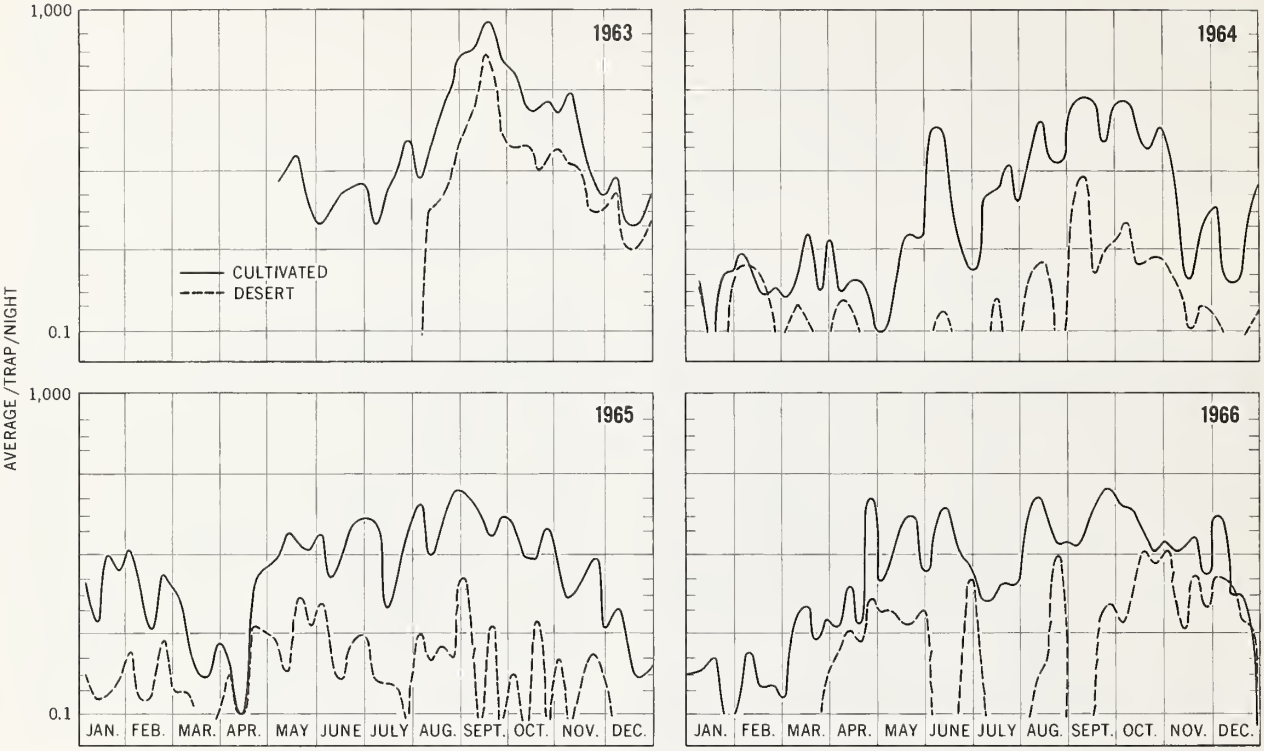

FIGURE 9.—Yellow-striped armyworm moth populations, 1963–66.

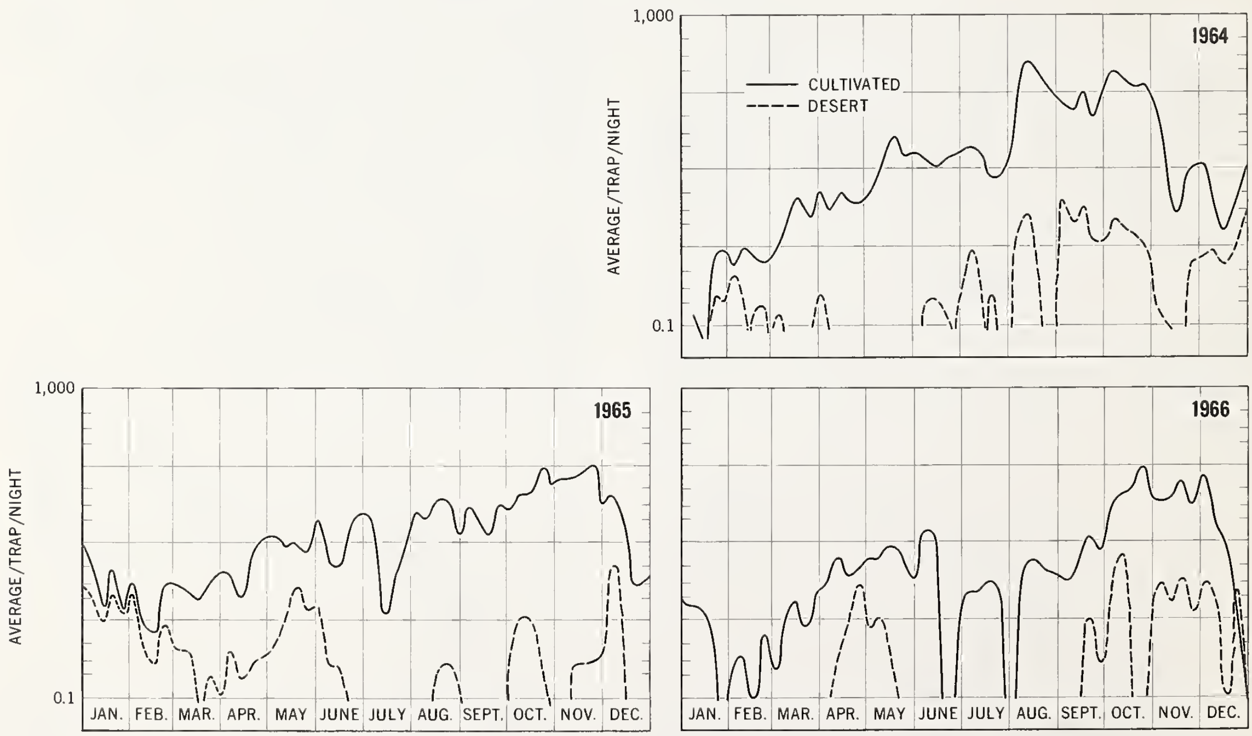

FIGURE 10.—Granulate cutworm moth populations, 1964–66.

and feed above ground at night, this insect on desert plants could easily be overlooked. Extreme damage by an unidentified cutworm on spectacle-pod mustard (*Dithyrea wislizenii* Engelmann) was observed in the spring of 1959 along the bed of the Salt River south of Phoenix, Ariz. These insects had completely eliminated stands of this plant over a considerable area and were present in large numbers just beneath the surface of the sandy soil. This observation indicates the possibility of cutworms breeding on desert plants if conditions are favorable. However, data in figure 10 would indicate that the primary source of at least the granulate cutworms in south-central Arizona is within cultivated areas.

DISCUSSION AND CONCLUSIONS

One of the most important findings in these studies is the buildup in south-central Arizona of large numbers of moths of the cabbage looper, corn earworm, beet armyworm, and yellow-striped armyworm in August and September. The data indicate that these moths are produced largely in irrigated cultivated areas rather than in semiarid desert areas.

All these insects are pests of cotton. Since over 250,000 acres of this crop is in prime condition for insect attack during the summer, it is logical to believe that many of these moths emerge from cotton during August and September. Unfortunately these population peaks come at a time when winter vegetables, primarily lettuce, are being planted and the moths are literally waiting for the emergence of the young plants on which to lay their eggs. Vegetable crops planted in winter and early spring escape most of these insects as is shown in the seasonal population graphs.

The desert areas surrounding the cultivated areas in south-central Arizona are of secondary importance for breeding of the cabbage looper and beet armyworm. Moths fly periodically from cultivated into desert areas, and if suitable host plants are available, they may breed for a time. However, most of the desert food plants are annuals, which are dependent on rainfall. Precipitation in the south-central Arizona desert is low and erratic, 7 to 9 inches annually in most areas surrounding the Salt River Valley. Consequently, desert food plants are not a dependable breeding source. A comparison of flight data for the corn earworm, yellow-striped armyworm, and granulate cutworm moths indicates that desert breeding areas are of even less importance for these insects.

The confinement of breeding primarily to cultivated areas and the very low winter and early-spring populations should be favorable for the development and application of population suppression methods early in the season on an areawide basis.

SUMMARY

The larvae of several noctuid moths are economically important insect pests of vegetable crops. They include the cabbage looper (*Trichoplusia ni* (Hübner)), the corn earworm (*Heliothis zea* (Boddie)), the beet armyworm (*Spodoptera exigua* (Hübner)), the yellow-striped armyworm (*Prodenia ornithogalli* Guenée), and the granulate cutworm (*Feltia subterranea* (F.)). The seasonal occurrence and flight patterns of these moths were studied during 1963–66 in south-central Arizona by means of traps with 15-watt blacklight lamps. Eight of these BL traps were set up within the cultivated area and four in the desert from 2½ to 12 miles from this area. They were operated every night and collections were made three times each week, except during peak summer populations when catches were too large to handle on this basis. During this period the traps were operated only 1 night each week. Other BL traps were operated temporarily on a 1-night basis 10 to 80 miles from the cultivated area.

Experiments indicate that the distance 15-watt fluorescent BL lamps were attracting moths of the cabbage looper, corn earworm, beet armyworm, and yellow-striped armyworm was between 50 and 100 feet but was somewhat less for moths of the granulate cutworm. Traps were less effective on moonlight nights. But when BL traps were baited with a female sex attractant, they caught as many or more males on moonlight nights as on dark nights. The difference in trap catch was attributed to

reduced trap efficiency on moonlight nights rather than reduced moth activity.

Data presented as seasonal curves show very low populations during winter and early spring but very high populations of all these insects during August and September. Since this is when winter vegetables are planted in south-central Arizona, these crops are heavily damaged. Data also show that the primary source of infestation for all five insect species is within the cultivated area, with some breeding in the desert. Cotton is indicated as the principal breeding host.

☆U.S. Government Printing Office: 1968 O—292-696